Navigation and Landing Functional Programs

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2-Navigation and Landing

N03–Instrument Landing System (ILS)

Program Description: The instrument landing system (ILS) is the precision landing system used for safe and efficient landing operations during instrument meteorological conditions (IMC).

This program ensures that ILS's will remain viable until the transition to space-based navigation. New ILS's may be installed or upgraded at selected large- and medium-hub airports. The program includes the following projects:

Mark-20 (MK-20) ILS. This project establishes new Category I/II/III instrument landing systems, upgrades existing facilities, and replaces older Category II/III and MK-1A systems.

Service Life Extension Program (SLEP). This project upgrades MK-1B and 1C systems to MK-1F capability. It also provides for a remote maintenance monitoring (RMM) capability for these systems.

End Fire Glide Slope (EFGS) Antenna System. This project provides antenna systems for installation where conventional (image) glide slope systems cannot be economically installed. It also provides full logistic support data and materiel not previously procured.

Approach Lighting System with Sequenced Flashing Lights (ALSF-2). This project provides ALS equipment for new Category II/III runways and ALSIP programs.

Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). This project provides ALS service for Category I runways for new and established ALSIP programs.

Low Power Distance Measuring Equipment (DME). This project provides Low Power DME's, which are RMM capable, for installation with ILS's.

Portable ILS Receivers (PIR). This project provides replacement PIR's for field calibration and maintenance of ILS's.

Snow Depth Monitor. This project provides snow depth monitors to measure snow accumulation that may affect the glide slope angle. The monitor alerts maintenance personnel for action at remote ILS sites.

Airport Improvement Program and Airport Development Aid Program (AIP/ADAP). This project also continues assumption responsibility of AIP/ADAP systems per Public Law 103-331, Section 317, that mandates ILS takeover.

Products:

- 14 ALSF-2 lighting systems (ALSIP)
- 140 service life extension program (SLEP) kits
- Eight EFGS antenna systems
- 48 Low Power DME's
- 730 PIR's
- 75 snow depth monitors
- 20 ALSF-2's (ILS Establish)
- 37 MALSR's (ILS Establish)
- 40 ILS's (AIP/ADAP units)
- 32 MALSR light systems (AIP/ADAP units)
- Six ALSF-2 light systems (AIP/ADAP units)
- Seven runway visual range systems (AIP/ADAP units)
- Seven distance measuring equipment (AIP/ADAP) units
- Seven Outer Markers (AIP/ADAP units).

Accomplishments (1/97–9/98):

- Delivered first production MALSR
- Delivered first production ALSF-2
- Delivered 57 MK-20 ILS's to operational sites and 3 to the FAA Logistics Center for Program Manager control
- Upgraded MK-1A/1B/1C ILS to the MK-1F configuration at 140 airports through the service life extension program (SLEP), Phases 1 and 2
- Completed manufacture of all the LPD antennas and v-ring antenna conversion kits under SLEP, Phase 3
- Manufactured RMM equipment kits for the first 20 airports under SLEP, Phase 4
- Upgraded approximately 30 airports to MK-1F ILS capability by leapfrogging equipment released by MK-20 ILS installations
- Delivered 455 PIR's to operational sites
- Delivered eight EFGS antenna systems to operational sites
- Delivered 47 Low Power DME's to operational sites and 1 to the William J. Hughes Technical Center for continued testing of the RMM function.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

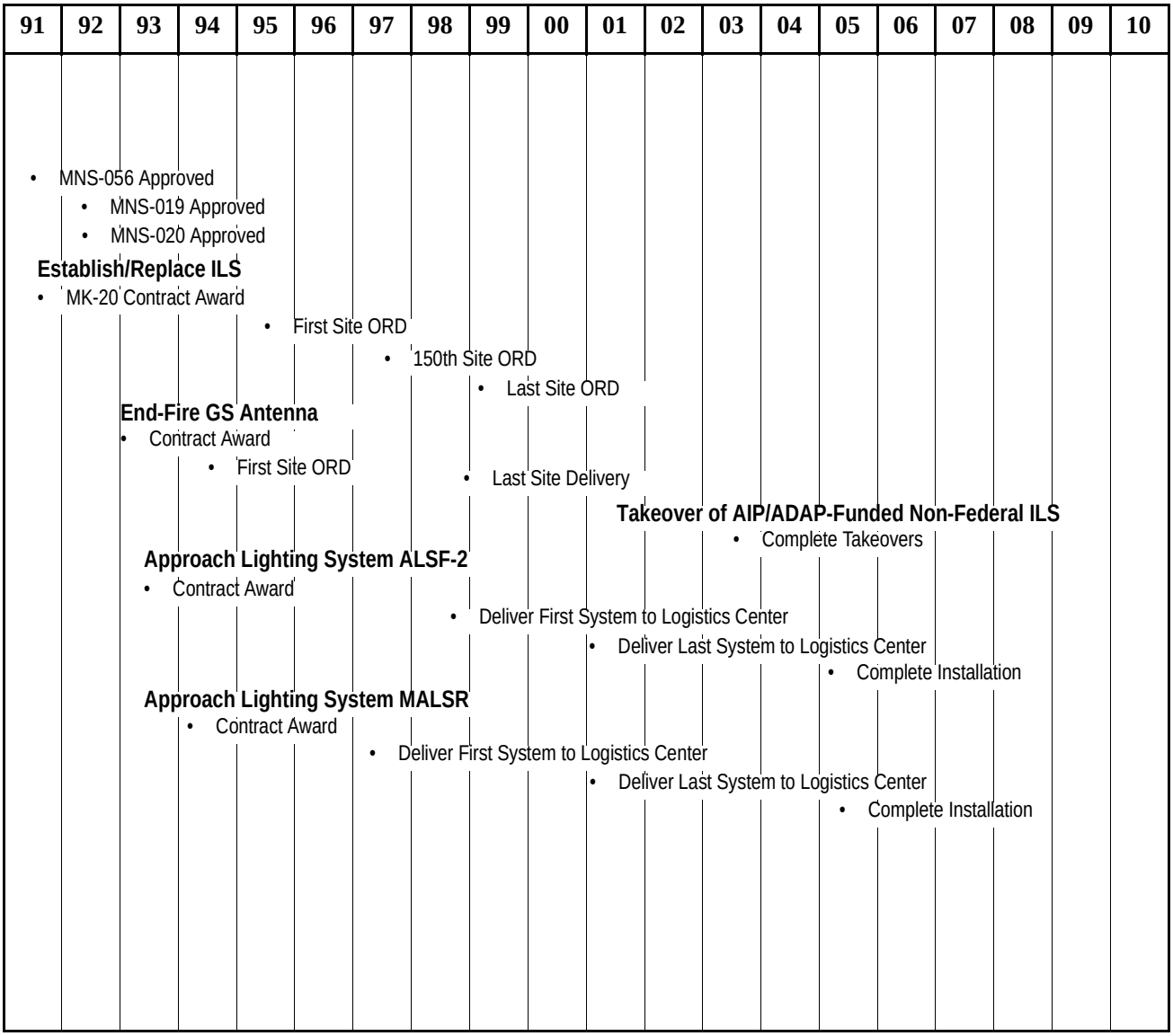
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- Airport Systems International, Incorporated
  Overland Park, Kans.
- Airsys ATM
  (formerly Wilcox Electric, Incorporated)
  Shawnee, Kans.
- DME Corporation
  Fort Lauderdale, Fla.
- NAVAIDS, Incorporated
  Buchanan Dam, Tex.
- NAVCOM Systems, Incorporated
  Manassas, Va.
- New Bedford Panoramex Corporation
  Upland, Calif.
- Roselm Industries, Incorporated
  South El Monte, Calif.
- Teledyne Controls
  Los Angeles, Calif.
- Watts Antenna Company
  Herndon, Va.

Schedule: N03 - Instrument Landing System (ILS)



N04 –Visual Navaids

Program Description: Visual lighting systems facilitate the pilot's transition from instrument to visual references during instrument approaches and provide supplemental guidance during visual approaches. Some existing visual Navaids for international runways do not meet International Civil Aviation Organization (ICAO) standards. However, the United States has agreed to comply with international standards.

This program procures and installs approach lighting systems. It also modernizes existing airport lighting systems with frangible (breakaway) support structures, which will reduce aircraft damage in case of an accident. The program provides equipment to establish remote radio control systems for the visual Navaids and includes the following projects:

Approach Lighting System Improvement Program (ALSIP). This project replaces hazardous nonfrangible airport lighting systems (ALS), either MALSR or ALSF-2, with frangible structures as requested by the National Transportation Safety Board (NTSB) in 1978.

Approach Lighting System with Sequenced Flashing Lights (ALSF-2). This project provides ALS equipment for new Category II/III runways.

Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). This project provides ALS service for Category I runways for new establishments and ALSIP programs.

Precision Approach Path Indicator (PAPI). This project provides vertical, visual guidance for pilots landing at an airport. It replaces existing visual approach slope indicator (VASI), as required by ICAO, and provides for new establishment needs.

Remote Radio Control System (RRCS) and Remote Radio Control Interface Unit (RRCIU). These projects provide remote radio control of the ALS from the tower and negate the requirement to install expensive control cables.

Runway End Identification Lights (REIL). This project provides visual indication of the runway threshold for new establishments.

Products:

- 14 ALSF-2 lighting systems (ALSIP)
- 44 MALSR lighting systems (ALSIP)
- 247 PAPI landing aids
- 170 PAPI systems (Phase 1) (ICAO runways)
- 1150 PAPI systems (Phase 2)
- 251 REIL systems
- 300 RRCS's.

Accomplishments (1/97–9/98):

- Delivered 237 PAPI's
- Commissioned ALSF-2 at Alliance, Tex.
- Sponsored first government/industry/academia approach lighting systems symposium.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

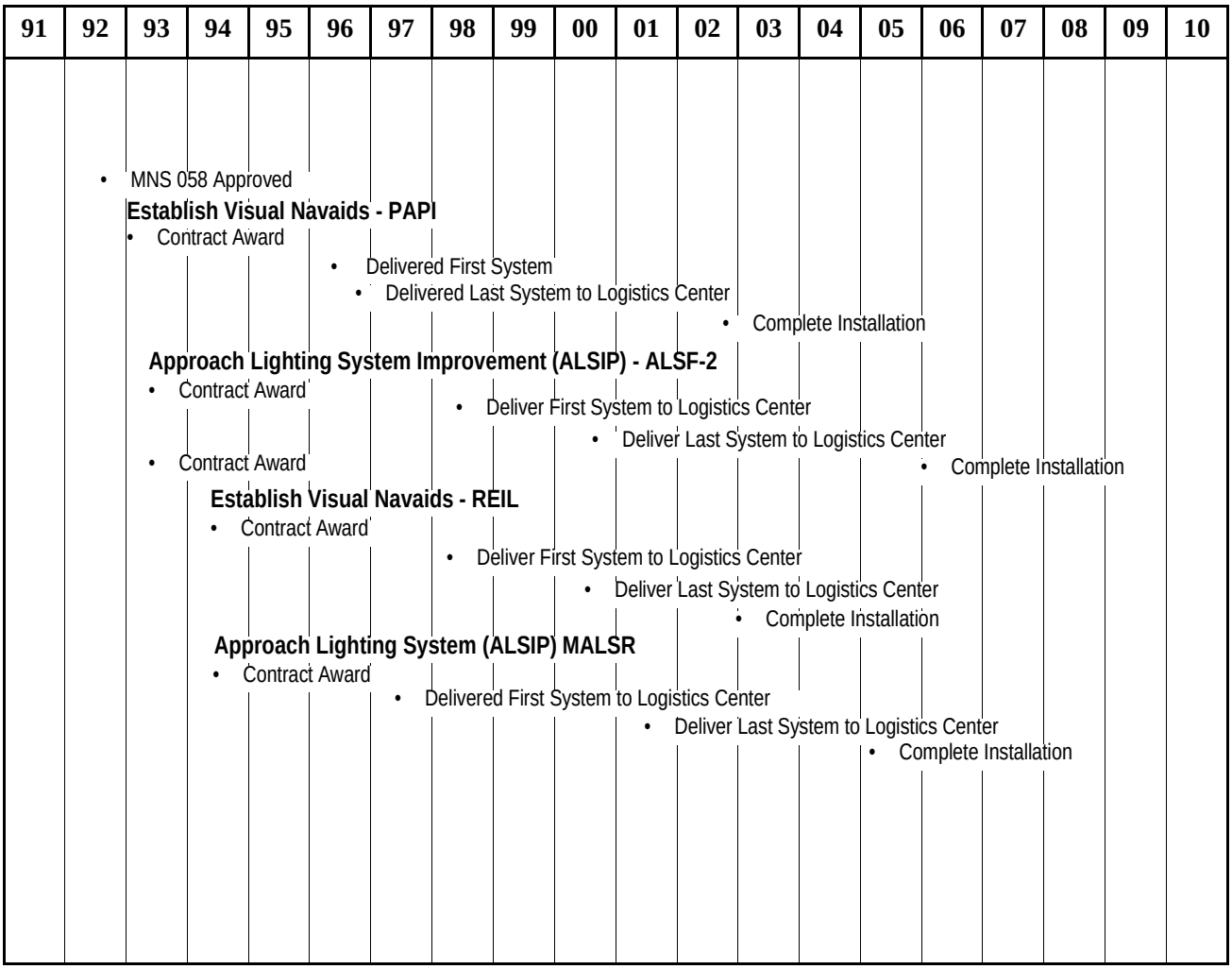
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- DME Corporation
  Fort Lauderdale, Fla.
- New Bedford Panoramex Corporation
  Upland, Calif.
- Sonicraft Incorporated
  Chicago, Ill.

Schedule: N04 - Visual Navaids



N05–Low-Power TACAN Antennas

Program Description: The Department of Defense (DOD) requires that existing tactical air navigation (TACAN) equipment be sustained until replaced by the space-based navigation system. The 30-year-old TACAN antennas are obsolete and their rotating elements are difficult to obtain.

This program acquires and replaces existing TACAN antennas with new, low-power antennas. The new antennas reduce input power requirements from 5,000 watts to 400 watts while maintaining the same radio frequency power output. This eliminates the need for backup diesel engine generators at TACAN sites. The FAA and DOD jointly fund this program: DOD will fund 119 antennas; the FAA will fund 84 antennas.

Products:

- 203 Low-Power TACAN antennas.

Accomplishments (1/97–9/98):

- Delivered 133 low-power TACAN antennas
- Commissioned 148 antennas.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

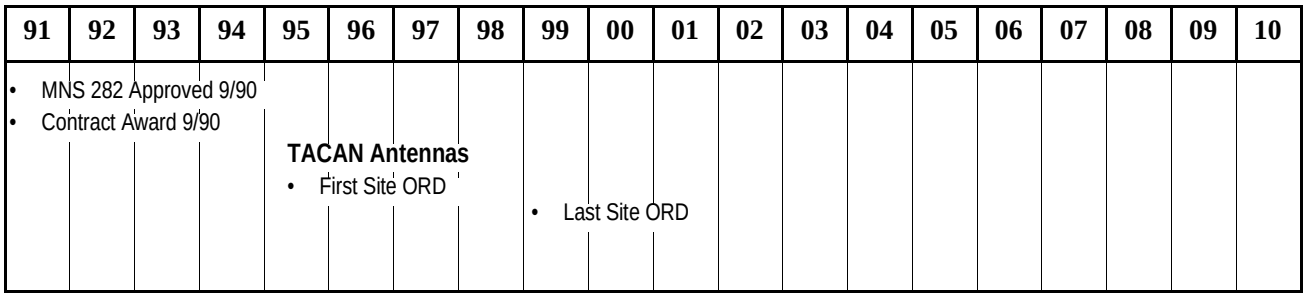
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- COMSAT/R&I
  Sterling, Va.

Schedule: N05 - Low-Power TACAN Antennas



N06–VORTAC

Program Description: The FAA must sustain existing very high frequency omnidirectional range with distance measuring equipment (VOR/DME) navigational aids until they are replaced by the satellite-based navigation system.

This program replaces, relocates, converts, modifies, and establishes very high frequency omnidirectional range with tactical air navigation equipment (VORTAC), VOR/DME, and very high frequency omnidirectional range (VOR) Test facilities. It also provides engineering support to improve VORTAC performance and effectiveness. Some conventional VOR systems will be converted to Doppler systems to solve site problems and provide the required service volume. Tactical air navigation (TACAN) equipment will be modified to use battery backup power. This is possible due to the reduced power requirements resulting from installation of low-power antennas (see N05). Switching to battery backup allows the FAA to remove diesel engine generators and fuel storage tanks.

Products:

- 70 VOR/DME units
- 115 Doppler VOR conversion kits
- 203 TACAN battery backup kits.

Accomplishments (1/97–9/98):

- Commissioned 26 VOR/DME's
- Delivered 49 DME systems; installed 38.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

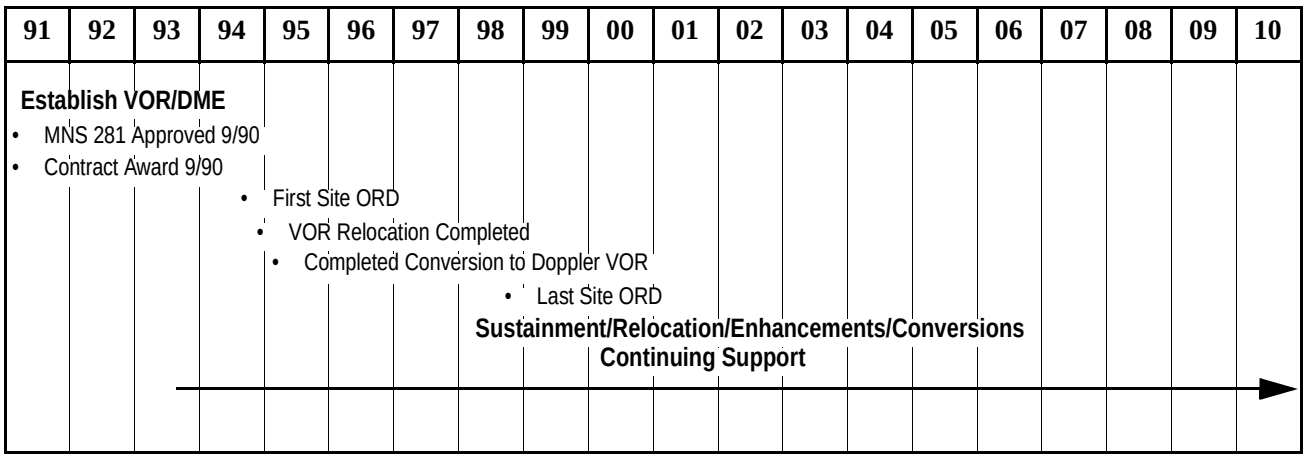
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- DME Corporation
  Fort Lauderdale, Fla.
- Wilcox Electric
  Kansas City, Mo.

Schedule: N06 - VORTAC



N08–Runway Visual Range (RVR) Systems

Program Description: RVR equipment provides a standardized, accurate means of measuring runway visibility during instrument meteorological conditions. Earlier RVR systems do not support Category IIIb instrument approach procedures, which limits capacity at many airports. Additionally, blowing rain or snow may degrade the performance of earlier systems.

This program procures new-generation RVR systems that will support all precision instrument approaches (Category I/II/IIIa/b), are not affected by adverse weather, and incorporate remote maintenance monitoring. The new RVR's are mounted on frangible structures that improve safety by mitigating aircraft damage from accidental impacts.

Products:

- 264 Runway Visual Range systems.

Accomplishments (1/97–9/98):

- Delivered 20 RVR systems to operational sites
- Commissioned RVR systems at 60 airports.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

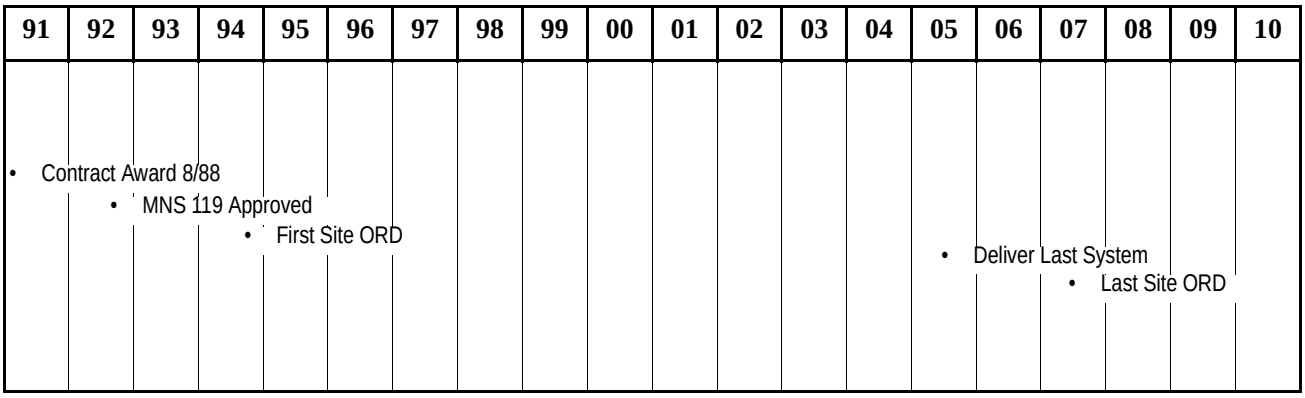
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- Teledyne Controls
  Los Angeles, Calif.

Schedule: N08 - Runway Visual Range (RVR) Systems



N09–Sustain Distance Measuring Equipment (DME)

Program Description: Most existing distance measuring equipment (DME) units are technologically obsolete, maintenance-intensive, and are at or near the end of their expected service life. DME repair parts are unavailable or difficult to obtain, yet the units must be maintained until the proposed space-based navigation system is implemented.

This program replaces obsolete DME units collocated with instrument landing systems or terminal non-directional beacons with modern units.

Products:

- 225 DME units.

Accomplishments (1/97–9/98):

- Revalidated Mission Need Statement (MNS) 098
- Delivered 49 DME systems, installed 38.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

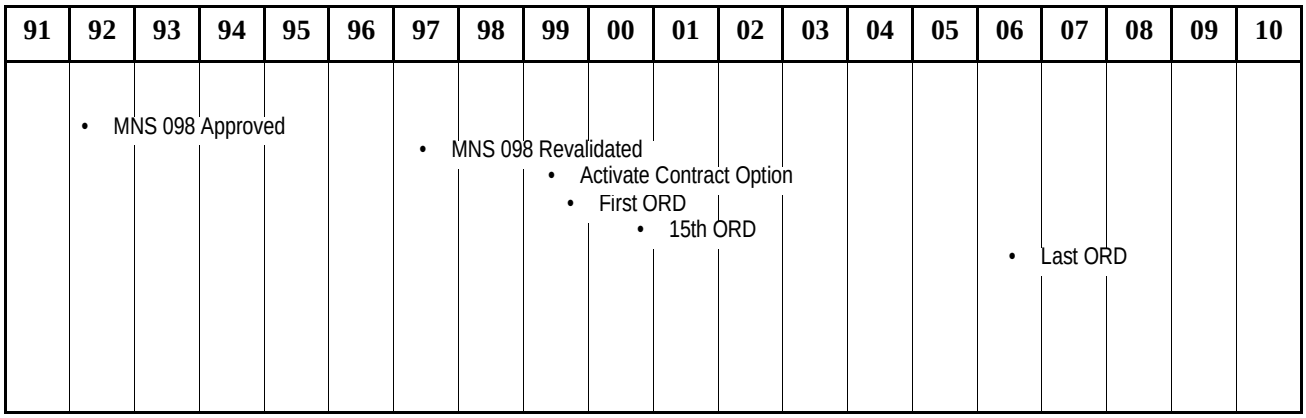
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- Units will be procured from the General Services Administration schedule.

Schedule: N09 - Sustain Distance Measuring Equipment (DME)



N10–Sustain Nondirectional Beacon (NDB)

Program Description: Approximately 75 percent of the FAA's NDB's use vacuum tube or early solid-state technology. Although the NDB's have exceeded their expected service life by 10 or more years, the FAA must sustain these navigational aids until the proposed satellite-based navigation system is implemented. This program procures replacement units or parts through a General Services Administration (GSA) service contract as required.

Products:

- Low-, medium-, and high-power transmitters
- Antennas
- Monitor receivers.

Accomplishments (1/97–9/98):

- Delivered 20 NDB systems.

Sponsor Organization:

- ARN-100, Navigation/Landing/Surveillance Division.

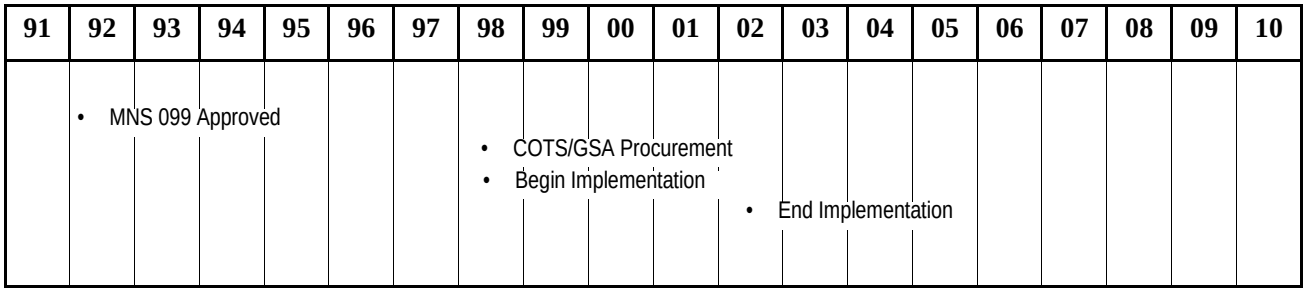
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- Nautel Maine
  Bangor, Maine.

Schedule: N10 - Sustain Nondirectional Beacon (NDB)



N11–Loran-C Monitors and Transmitter Enhancements

Program Description: Long-range navigation (Loran-C) is a radio navigation system that provides visual flight rules (VFR) and supplemental instrument flight rules (IFR) en route navigation in the contiguous United States. Loran-C, is operated by the U.S. Coast Guard (USCG).

The FAA has procured an automatic blink system (ABS) that would work with Loran transmitters to notify pilots when the Loran-C signal becomes out of tolerance. System implementation is on hold, pending policy decisions.

Products:

- 105 Automatic Blink Systems (ABS).

Accomplishments (1/9–9/98):

- Tested 10 ABS's at three mid-continent chain transmitter stations.

Sponsor Organization:

- Required by statute.

Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- NAVCOM systems
  Manassas, Va.

Schedule: N11 - Loran-C Monitors and Transmitter Enhancements

91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
									• Complete installation of ABS units in all U.S. Loran-C transmitters										

N12–Augmentations for the Global Positioning System (GPS)

Program Description: The Global Positioning System (GPS) provides a practical starting point for eventual development of a seamless global navigation satellite system. However, GPS, as designed, developed, and deployed by the Department of Defense (DOD), will not satisfy all civil aviation requirements for navigation and landing. For use in civil aviation, augmentations will be required to:

- Improve GPS accuracy for precision approaches
- Provide integrity and continuity for all phases of flight
- Provide the necessary availability to meet radio navigation requirements.

The first step in this augmentation is the Wide Area Augmentation System (WAAS), designed to provide a navigation and landing capability down to or near the lowest Category I decision height of 200 feet, depending on obstacle clearance and runway lighting.

The second step is the Local Area Augmentation System (LAAS), being designed to fulfill navigation and landing requirements for Category I at locations where WAAS cannot, and to meet the more stringent Category II/III requirements.

Wide Area Augmentation System (WAAS). This acquisition program will provide the augmentation needed to make GPS fully usable for en route, terminal, nonprecision, and Category I precision approaches. WAAS will provide the required accuracy, availability, continuity, and operational integrity augmentations to GPS.

WAAS consists of a network of precisely located monitors over North America that determine the integrity and accuracy of each visible GPS satellite. Augmentation equipment will generate error correction data and broadcast a signal integrity and position correction message to users via geostationary communications satellites. Broadcasts from the geostationary satellites are on the same frequency as GPS and are suitable for ranging.

The WAAS project also supports development of standards, certification, facilities, and procedures for operational use of WAAS in the NAS. This includes requirements such as GPS procedures for use by air traffic, unique approach procedures for each location, obstacle clearance requirements, aircraft separation standards, airport surveys, support for training programs for civil pilots, and the revision of FAA regulations and documents to reflect satellite navigation use.

To facilitate implementing preplanned product improvements (P^3I) and technology enhancements, a phased approach to system development is being used. Phase 1 will deliver an initial operational capability. Delivery of additional capability is contingent on two factors: (1) results of an independent risk assessment, scheduled for completion in early 1999, and (2) results of an ongoing alternatives analysis.

Local Area Augmentation System (LAAS). This program is being developed to fulfill navigation and landing requirements (such as availability) at locations where WAAS is unable to provide Category I precision approach, and to provide Category II/III precision approach requirements. LAAS is also expected to enable users to safely taxi aircraft in low-visibility situations. A Government and Industry Partnership (GIP) has been established to develop LAAS for navigation and precision approach of aircraft. This partnership provides in-kind services for developing a certified Category I LAAS. The partnership is a three-stage effort:

- Standards Development
- Full-Scale Development (FSD) for Category I
- FSD for Category III.

Satellite Navigation (SATNAV) Program. The primary mission of this project is to provide a satellite-based navigation capability for all phases of flight in the NAS, from en route through precision approach. GPS, when augmented with WAAS and LAAS, will provide a satellite-based 3-dimensional primary means of navigation suitable for civil and military aircraft equipped with a certified GPS/WAAS/LAAS receiver. SATNAV will integrate all phases of flight in the NAS, from departure, en route, and arrival through precision approach.

GPS Additional Civil Frequencies. On September 1, 1998, the FAA Administrator informed the Secretary of Transportation that the FAA has an operational requirement for an additional signal in the Aeronautical Radionavigation Service (ARNS) band for GPS. On December 14, 1998, the Office of Management and Budget (OMB) provided guidance to the DOD and DOT informing them that the White House had made its decision on second and third civil frequencies. The second civil frequency, at 1227.6 MHz will be for non-safety-of-life applications, and the third civil frequency at 1176.45 MHz will be for safety of life, ARNS-protected applications such as civil aviation. DOD and DOT will work out the technical issues and cost and operational impact by August 15, 1999.

The FAA is responsible for managing the aeronautical radio navigation band because the primary users of an aeronautical radionavigation signal will be the aviation community. However, all users of the GPS system, including land transportation and maritime users, will be able to use the signal to improve accuracy, integrity, and availability of the GPS service once this signal is available. The FAA will manage the acquisition of this signal in such a way as to ensure that it will meet all U.S. and International Civil Aviation Organization (ICAO) requirements for aircraft use for safety of life operations.

Improved navigation services resulting from the addition of the third civil frequency is expected to help the FAA achieve its goal of reducing the current rate of aviation accidents in U.S. domestic operations. Additionally, the enormous growth projected in the number of airplane operations worldwide may result in a sharp increase in the number of major accidents per year. Avionics can be built to use the third coded civil frequency to minimize the impacts on interference.

Design, development, and implementation of the second and third coded civil frequencies is a joint effort of the Department of Transportation (DOT) and the U.S. Air Force Joint Program Office (JPO) for the GPS program. Initial funding will continue the design of the third signal and begin implementation of the signal on the Block IIF GPS satellites, which are currently under production. A portion of the funding for this project will be transferred to the GPS JPO for execution of an ongoing contract with the satellite supplier. The FAA will oversee the performance of the contractor to ensure that the signal being designed and implemented will result in a signal usable by the global civil aviation community.

Products:

- WAAS
- LAAS
- GPS overlay procedures
- Nonprecision and precision approach procedures
- GPS second and third civil signals.

Accomplishments (1/97–9/98):

- Received JRC acquisition program baseline (APB) approval for WAAS/LAAS on January 9, 1998
- Completed preliminary and critical design reviews for all WAAS system components
- Integrated WAAS prototype software with the National Satellite Test Bed (NSTB) to further software development and testing (Collecting and analyzing data from these tests is a critical risk mitigation strategy during the critical design phase.)
- Completed hardware purchasing, site installation, and acceptance testing at 25 ground locations for the WAAS initial operational system (Phase 1)
- Completed two incremental software builds to include software coding and unit testing and initiated developmental test and evaluation of all WAAS software components
- Implemented detailed WAAS technical performance metrics to obtain a more accurate assessment of the contractor's performance by using the results to provide analysis and early warning of problems (These metrics are integrated with cost and schedule “earned value” and provides

management with a proactive approach for overseeing contractor performance.)

- Conducted, in conjunction with Iceland and Chile civil aviation authorities, WAAS technology flight demonstrations in Keflavik, Iceland and Santiago, Chile (In Iceland, CAA Beechcraft King Air 200, United Kingdom National Air Traffic Services BAC 1-11, and the FAA Boeing 727 test aircraft performed Category I precision approaches using navigation signals from the FAA National Satellite Test Bed (NSTB) and the United Kingdom NATS Northern European Satellite Test Bed (NESTbed).)

- Continued NAS implementation initiatives (i.e., WAAS approach procedures, air traffic route restructures, etc.) required to enable use of WAAS in the NAS

  – Complete analysis of the test data that will lead to finalizing GPS/WAAS precision approach TERPS criteria for the FAA National Flight Procedures Office.

  – Published the minimum operational performance standards (MOPS) for GPS/WAAS airborne equipment (Document No. RTCA/DO-229A, Change 3) on June 8, 1998.

- Implemented seven GPS routes in the northeast, between Washington, New York, and Boston ARTCC's, providing direct routings to GPS-equipped aircraft

- Presented LAAS architecture in detail to the international community at the Global Navigation Satellite System (GNSS) meeting in Australia (The briefing resulted in the agreement by many members of the international community that the LAAS architecture was technologically desirable, and that the VHF data broadcast was the correct frequency spectrum for LAAS data transmission.)

- Conducted LAAS flight tests at the William J. Hughes Technical Center (The system used for the flight test was a breadboard system developed by Ohio University. Preliminary results substantiated the technological estimates.)

- Delivered the first of four LAAS multipath mitigating antennas to the FAA Technical Center in early November 1997 (Completed the Multipath Mitigating Technique(s) Study. Results were favorable and indicate that the multipath mitigating antenna remains the most desirable method for multipath mitigation.)

- Released the LAAS announcement inviting interested industry parties to attend a briefing at the FAA auditorium on April 3 (This meeting described the Other Transaction Authority, the strategy for accomplishment of full-scale development (FSD), and invited industry comments on these subjects. On September 29 and 30, 1998, Defense Advanced Research Projects Agency (DARPA) conducted an Office of Technical Assessment **(**OTA) workshop for FAA, Honeywell, and Raytheon.)

- Released the LAAS screening for information request (SIR) to industry on April 22, 1998. The SIR is seeking partnership(s) with industry teams to develop, integrate, and certificate a LAAS ground station, airborne receiver, and facility to install and certify a LAAS (The SIR can be found on the LAAS Web site (http://gps.faa.gov/laas/index.htm).)

- Completed LAAS test prototype (LTP) flight tests at Fairbanks International Airport from June 8 to 12, 1998, and at Cold Bay Airport from June 14 to 18, 1998 (Preliminary data analysis shows that at both test locations, the LTP provided guidance with a 95 percent error estimate of less than 0.4m horizontally and 1.0m vertically.)

- Completed first release of the LAAS performance and functional specification supporting Category I approach and landing operations.

Sponsor Organization:

- AVR-1, Regulation and Certification Service.

Performing Organization:

- AND-730, Communication, Navigation, and Surveillance Systems.

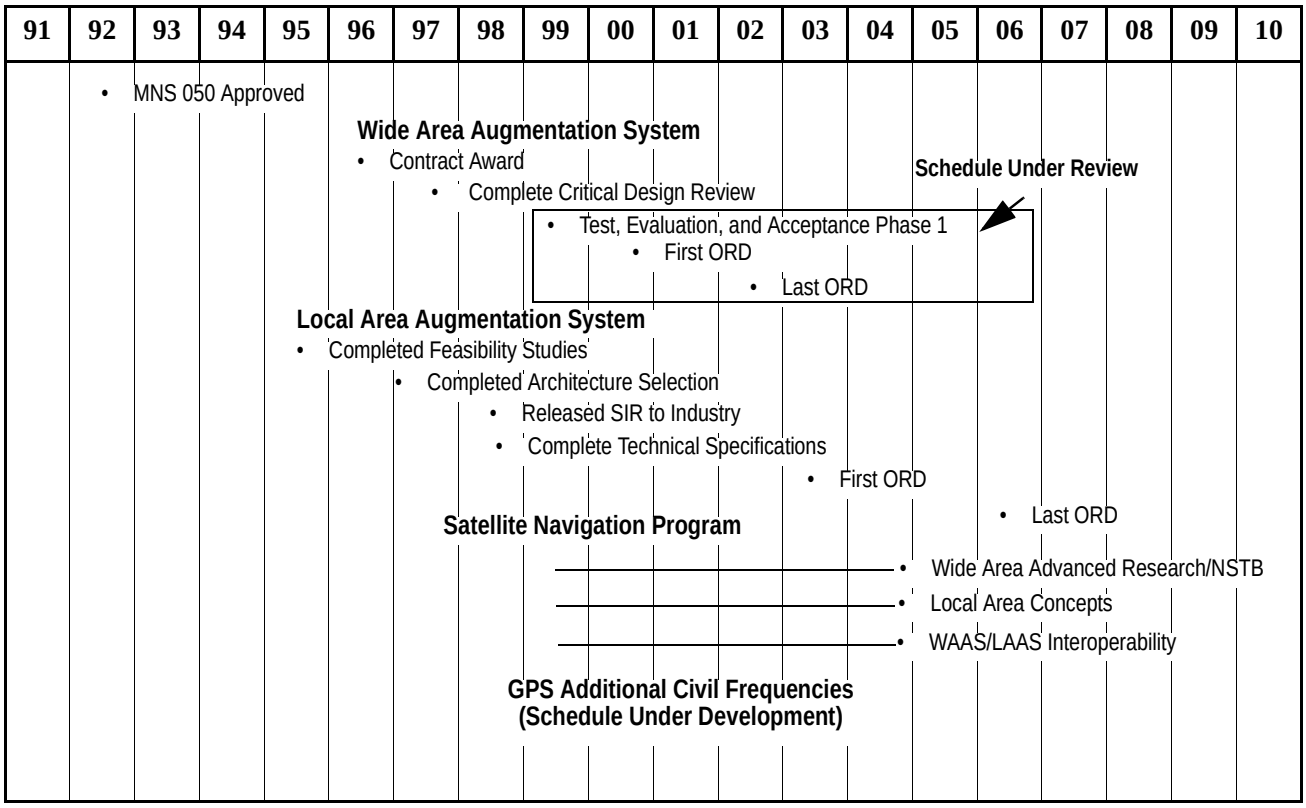
Contractors:

- Raytheon Systems Company
  Fullerton, Calif.

- COMSAT
  Clarksburg, Md.

- Boeing Missiles and Space Company

Schedule: N12 - Augmentation for the Global Positioning System (GPS)



N13–Transponder Landing System (TLS)

Program Description: TLS (also known as tactical landing system) is a precision approach system that provides a Category I instrument landing system (ILS) signal for an aircraft being tracked in the approach sector. It is a non-Federal air navigation facility, approved for operation by commercial air carriers and general aviation. Some operators have expressed an interest in exploring this technology to help mitigate controlled flight into terrain (CFIT) and increase capacity in constrained terminals.

This congressionally directed project will install TLS systems at six locations. The project will develop operational procedures and support capability for TLS, assess the technology and its capability to meet needs that cannot be met by current technologies, and assess future growth potential of the technology to mitigate CFIT.

Products:

- Six TLS units.

Accomplishments (1/97–9/98)

- Not applicable because this program will be initiated in FY 1999.

Sponsor Organization:

- None.

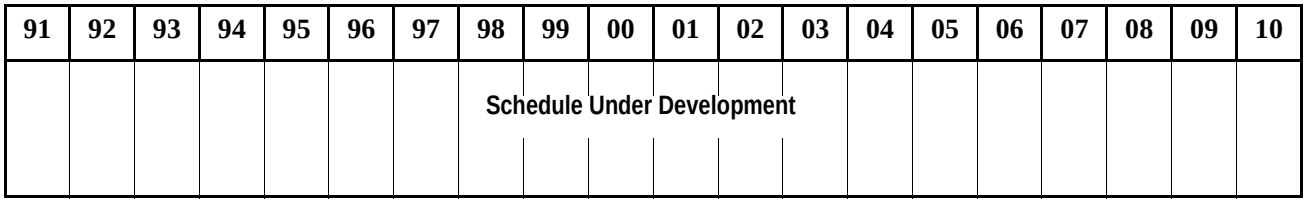
Performing Organization:

- AND-700, Aircraft, Avionics, and Navigation Systems Integrated Product Team.

Contractors:

- Advanced Navigation and Positioning Corporation (ANPC) (Developer)
  Hood River, Oreg.

Schedule: N13 - Transponder Landing System (TLS)



New Navigation and Landing Mission Needs (2001–2004)

New navigation and landing plans expected to need funding during the next 5 years include:

- Upgrading the approach lighting systems (ODALS, SSALR, MALSR, MALSF, and REIL) beyond the current programs
- Sustaining and relocating legacy Navaids
- Upgrading LORAN-C.

Actual requirements will be addressed through the Acquisition Management System.